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BRIGHTEN YOUR CORNER, BROADCAST NO. 7464. UNIVERSITY EXPLORER.

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LIGHTING RECOMMENDATIONS ALONG WITH DESIGN IMPLICATIONS ARE DISCUSSED. COMMENTS OF SEVERAL LEADING LIGHTING AUTHORITIES ARE INCLUDED. A SERIES OF LIGHTING CONSIDERATIONS RECOMMENDS--(1) CHILDREN CAN ACQUIRE AN AWARENESS OF THEIR LUMINOUS ENVIRONMENT THROUGH EARLY TRAINING, (2) INTENSITY, DISTRIBUTION, HORIZONTAL OR VERTICAL POLARIZATION AND THE COLOR OR SPECTRAL CHARACTERISTICS OF LIGHT MUST BE CONSIDERED IN SPECIFYING LIGHTING, (3) AMOUNT OF LIGHT IS PROPORTIONAL TO THE TYPE OF TASK PERFORMED, (4) CONCENTRATED BRIGHT LIGHT AGAINST DARK SURROUND CAUSES ADJUSTMENT OF THE EYE MUSCLES CONTINUOUSLY TO THE VARIATIONS IN LIGHT LEADING TO EYE FATIGUE, (5) CONTINUOUS OVERHEAD DIFFUSED LIGHTING IS THE MOST EFFICIENT AND ECONOMICAL FORM OF ARTIFICIAL LIGHTING, (6) WORK AREAS SHOULD NEVER BE DIRECTLY UNDER LUMINAIRE BECAUSE OF REFLECTED GLARE AFFECTING SPEED AND QUALITY OF PERFORMANCE RESULTING IN FATIGUE AND POOR RETENTION, (7) ANGLE AT WHICH MATERIAL IS HELD (TO LIGHT SOURCE) IS CRITICAL, (8) WHITE LIGHT IS BEST FOR MAXIMUM VISIBILITY ALTHOUGH THE AESTHETIC AND PSYCHOLOGICAL REACTIONS MUST BE CONSIDERED, (9) LUMINOUS TRANSLUCENT CEILINGS PRODUCE BEST QUALITY LIGHT, (10) SEVERAL LAYERS OF POLARIZING PANELS PROVIDE BEST REDUCTION OF GLARE, (11) BY TURNING ON SEVERAL LAMPS IN A ROOM, SHADOWS CAN BE REDUCED PREVENTING WEARINESS AND PERFORMANCE LAG OF THE INDIVIDUAL CAUSED BY POOL LUMINOUS ENVIRONMENT, AND (12) THE FIELD OF VIEW AT A DESK SHOULD BE KEPT AT A UNIFORM LEVEL OF BRIGHTNESS. (RK)

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EXPLORER: Just "around the corner" is a system of artificial lighting that is seven times more efficient than what you probably have in your home right now!

ANNOUNCER: The University of California welcomes you to its one thousand, nine hundred 85th broadcast featuring the University Explorer. His story today deals with a technological achievement that makes it possible for man to increase his play time as well as his productivity -- the ability to turn night into day by the use of electrical power. With a story entitled BRIGHTEN YOUR CORNER, here is Hale Sparks, the University Explorer.

EXPLORER: From the time man began searching for ways to control his destiny, he has waged a continuing battle against the dark. Darkness has been synonymous with danger down through the ages, for predators of all kinds have instinctively used the mantle of the night or the shadows of the day to hide their maneuvers. Until some eighty years ago, however, our only defense against the dark was an open flame -- the light from burning sticks ignited by a campfire, from skulls filled with animal fat, the kerosene lamps of our great-grandfathers, the flickering candles at the Palace of Versailles and the ghostly gaslight that illuminated the Victorian Era.

The theory of the flameless incandescent lamp was proposed as early as 1838 by a professor in Brussels who asserted that electricity would cause a small piece of carbon sealed in a vacuum to glow brightly. But it was almost half a century later when Thomas Alva Edison proved that this theory was practical. Edison's refinement of the incandescent light bulb in the 1880's made the Twentieth Century the brightest the world has ever known.

Lighting is a feature of our environment that is often taken for granted, despite the fact that experiments have shown that illumination can influence our work performance, our general comfort, our dispositions -- our attitude toward both the things and the people we encounter.

Recently, I talked with two scientists who are concerned with better lighting as a means to better vision. Dr. Philip F. O'Brien, associate professor of engineering on the Los Angeles campus of the University of California, is primarily interested in the way light behaves, and he is currently conducting experiments to learn more about the control of shadows. Dr. Niles Roth is engaged in research at the new Jules Stein Eye Institute at UCLA and through his studies he has become familiar with the responses of the human eye to different types of lighting.

Both of these scientists told me that the main reason we tend to be oblivious to the light around us is found in the superb adaptability of the eye itself. The human eye can adjust easily and automatically to an incredible range of light intensities. Dr. O'Brien gave the example of reading a newspaper in direct sunlight, which measures around 10,000 lumens per square foot. A lumen is simply a unit of measurement roughly equal to the amount of light thrown off by a small candle. At the other extreme, a person with normal vision can also read a newspaper by bright moonlight, which registers at about one-tenth of one lumen per square foot. A realization of this tremendous range makes it easier to understand why less drastic variations in light often go unnoticed.

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This insensitivity to the light around us as well as the failure to utilize existing light controls such as louvered shades has been clearly demonstrated in a number of experiments. Lighting Engineer O'Brien mentioned one study in which the Venetian blinds in a particular office building were all pre-set at about one foot from the sill. Occupants of the building were not aware that they were being tested -- and many weeks after the blinds had been placed at this arbitrary height, the great majority of the blinds remained untouched even though better illumination could have been achieved by slight adjustments. Dr. O'Brien says, "A sensitivity to the way light flows into a room is not a natural or native talent. It's something you must develop." He holds the opinion that with a little early training, young children could acquire an awareness of their luminous environment that would serve them well all their lives.

The other scientist at the Jules Stein Eye Institute -- Dr. Niles Roth -- says many people tend to think of light only in terms of quantity. He emphasizes there are other physical characteristics besides the intensity of light that must be considered. Distribution -- or the direction at which light rays strike the objects we are looking at -- is especially important. Whether the light is horizontally or vertically polarized is also a major factor in combatting glare. And the color -- or spectral characteristics of light -- has a lot to do with how the eye will react to it.

In spite of the many factors to be considered, a national authority on lighting claims that "the hardest question to answer is how much is required." Dr. H. Richard Blackwell, director of the Institute for Research in Vision at Ohio State University, says one reason this is true is that the amount of light varies greatly depending on the difficulty of the task to be performed. Researchers have found that the more difficult tasks require far more light than the easy ones. For example, a task that is only one percent more difficult requires 15 percent more light for equal performance.

Dr. Blackwell says engineers meet this problem by providing a level of lighting that will allow people to "see the kinds of things that are important for them to see," and in the case of the typical office, the values are usually somewhere between 100 and 120 foot-candles.

There may be certain tasks like threading a needle that can be facilitated by concentrating a beam of light on a small area. Generally, however, Dr. O'Brien says, "Such beam-lights as one often finds on desks and drafting tables represent a sort of nonsense approach. Many people seem to feel that light is similar to water, and that by focussing it onto a small area, like the jet from a fire hose, they are doing something constructive. Actually, the contrast created by concentrated bright light against rather dark surroundings is one of the poorest approaches to lighting, because the muscles of the eye must continually adjust to the variations in light. Repeated adjustments of this kind are a major cause of eye fatigue."

How should light be distributed, then, to minimize the fatigue factor? Dr. O'Brien contends that diffused lighting from overhead continues to be the most efficient and economical way of introducing artificial light into a room, though he foresees the diffusion of additional light through translucent walls as a practical trend in the future. A single overhead light or one row of light fixtures will never distribute light properly, says the University of California engineer. Dr. Blackwell states that the aim of design should be "to produce . . . the effect of indirect light without excessive cost for lighting energy."

Desks and work areas should never be directly under a luminaire -- or light source -- because reflected glare is at a peak in such locations. Guarding against glare is essential if one is to operate at a reasonably high performance level, since the light bouncing back from a printed page or reflectant object tends

to reduce contrast and dilute the images which form on the retina of the eye. When the eye receives signals that are not strong enough to perceive clearly, it backtracks to verify the information. This slowdown can affect both the speed and quality of one's performance.

Dr. Roth assured me that glare and lack of uniform lighting do not cause injury to the normal eye itself, but they are conducive to early fatigue and poor retention. Among young children who are just learning to read and write, poor lighting may foster inefficient learning patterns that persist all their lives.

According to Dr. O'Brien, almost all printed material has a specular component -- in other words, a property that reflects light. In a newspaper, he says, even the ink has this mirror-like quality. And the glossy paper that is used for the so-called "slick" magazines is obviously highly reflectant. So the angle at which you hold your reading material in relation to your source of light is a major consideration.

The visual scientist Dr. Roth says there's a very simple way to guard against glare by using a mirror to test the angle at which you are holding your reading material. Simply place the mirror on top of the surface of the printed page, and if it reflects any portion of the light source, your reading material is improperly situated.

To light an area efficiently, I have mentioned that the spectral characteristics which produce color should also be considered. Dr. O'Brien says, "There are no magic colors for better vision." And he recommends a white light as best where maximum visibility is the chief concern. But Dr. Roth adds that there are also aesthetic and psychological reactions to different hues of light which we need to think about. How people or merchandise look under a particular color of illumination can affect social attitudes, the sale of a product, or even our mental health.

When the San Francisco Bay Bridge first opened in 1936, low-pressure sodium vapor lights were used to illuminate the gigantic span. But because the yellow-orange hue from the big tubes made people riding in automobiles look a sickly gray color, the lights were highly unpopular with the motorists and were eventually replaced in spite of their efficiency and economy. Illuminating foodstuffs and apparel and entertainment so they will show off to advantage is an art in itself. The color of light cast on a plate of food in a restaurant or a New York cut at the butcher's can make it look either appetizing or nauseating. Variations in color can now be provided by fluorescent lights as well as the traditional incandescent bulbs, and most people seem to "feel better" with the rosier, more flattering hues rather than the cold-blue tones.

A great deal of intensive research has been conducted during the past ten years to find ways to improve residential and industrial lighting. Experiments conducted under the supervision of Dr. Blackwell at the Institute for Research in Vision at Ohio State University indicate that the best quality in lighting is produced by a luminous, translucent ceiling. The light source behind this luminous ceiling can be diffused by glass or plastic lenses, but the most effective way of reducing glare has proved to be the installation of several layers of polarizing panels.

"The right kind of polarization," states Dr. Blackwell, "requires that the light waves vibrate in an up-and-down plane rather than sideways." Vertically polarized light definitely reduces glare, and by the same token, it increases contrast and improves vision. He says the luminous ceiling, which has been used successfully in commerce and industry, is 53 percent more effective than ordinary strip lighting installations.

Significant advances have also been made in the design of light sources. Dr. O'Brien mentioned the development of the high-pressure sodium vapor lamp as one of the major achievements of the last few years. Unlike the old low-pressure lamps on the San Francisco Bay Bridge, they do not distort fleshtones, though their light is still much redder than daylight. This advance was made possible by the development of a new ceramic material that contains the high-pressure discharge. Until recently, no substance had been found that was strong enough to hold it. This new sodium vapor lamp has an amazing efficiency of 100 lumens per watt, more than twice the 40 lumens of the widely used fluorescent lamps. And the old-fashioned incandescent light bulbs give us a mere 15 lumens per watt. So this new sodium vapor tube can provide us with a system that is seven times more efficient than our incandescent lighting. Dr. O'Brien says the units that are now being produced by two of the major manufacturers of electrical equipment are created with industrial needs in mind, for they are 400 watt lamps. He feels, however, that it won't be long before the economical sodium vapor lamp finds its way into the home.

Another trend that the lighting engineer predicts is a dual-purpose system that will provide both light and heat. It does not take much more electrical energy to provide heat as well as light.

Dr. O'Brien has some suggestions for students and people who spend a good deal of their time at a desk, for there are several ways they can achieve a better lighting environment. The objective is to keep the levels of brightness within one's field of view at a uniform level. This rules out gooseneck lamps and any fixtures that throw a beam. Obviously, the light source should not be directly over the desk because this produces maximum glare and shadows from anything placed on the surface. In the work area, light pastel colors are superior to dark hues like black or mahogany because of their greater reflectance. A simple expedient to lighten a dark wall behind a desk is to cover the spot with white blotting paper, which tends to throw diffused light down onto the desk top.

And what do we do while we're waiting for luminous ceilings and translucent walls and high-pressure sodium vapor lamps to become standard features in our homes and work areas? Well, says Dr. O'Brien, take full advantage of what you have. Too many people entering a room stop with the flip of a single switch that turns on only one lamp. They make it more difficult to work or read by creating a small, contrasty area of light surrounded by darkness. Merely by turning on several lights in a room you can often reduce the shadows and ward off the weariness and performance lag caused by poor lighting. So until science and industry provide us with built-in artificial lighting systems that are virtually foolproof, these simple recommendations can help you to brighten your corner.

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(Produced for the University of California by Charles Levy and William Howe.)

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